resource allocation of physical resource blocks, each branch comprising one or more legal starting positions for resource allocation, each starting position being associated with a cluster of physical resource blocks, the number of starting positions being different on each branch, the size of the resource clusters of each branch being different, means for denoting each resource cluster with a predefined index, and means for allocating one or more clusters to a user equipment uplink connection.

[0017] According to another aspect of the present invention, there is provided a computer readable memory embodying a program of instructions executable by a processor to perform actions directed toward resource allocation of physical resource blocks, the actions comprising: utilizing a tree structure with more than one branch in the resource allocation of physical resource blocks, each branch comprising one or more legal starting positions for resource allocation, each starting position being associated with a cluster of physical resource blocks, the number of starting positions being different on each branch, the size of the resource clusters of each branch being different, denoting each resource cluster with a predefined index, and allocating one or more clusters to a user equipment uplink connection.

[0018] According to yet another aspect of the present invention, there is provided a computer readable memory embodying a program of instructions executable by a processor to perform actions directed toward resource allocation of physical resource blocks, the actions comprising: utilizing a tree structure with more than one branch in the resource allocation of physical resource blocks, each branch comprising one or more legal starting positions for resource allocation, each starting position being associated with a cluster of physical resource blocks, the number of starting positions being different on each branch, the size of the resource clusters of each branch being different, denoting each resource cluster with a predefined index, and allocating one or more clusters to a user equipment uplink connection.

LIST OF DRAWINGS

[0019] Embodiments of the present invention are described below, by way of example only, with reference to the accompanying drawings, in which

[0020] FIG. **1**A shows a simplified block diagram illustrating an exemplary system architecture;

[0021] FIG. **1**B illustrates examples of apparatuses according to embodiments of the invention;

[0022] FIGS. **2**A to **2**E illustrate exemplary resource allocation tree structures;

[0023] FIGS. **3**A and **3**B illustrate two examples of sounding reference signal tree structures;

[0024] FIGS. **4**A, **4**B and **4**C are flowcharts illustrating embodiments; and

[0025] FIG. **5** is a flowchart illustrating an embodiment from the user equipment point of view.

DESCRIPTION OF SOME EMBODIMENTS

[0026] Exemplary embodiments of the present invention will now be described more fully with reference to the accompanying drawings, in which some, but not all embodiments of the invention are shown. Indeed, the invention may be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will satisfy applicable legal requirements. Although the specification may refer to "an", "one", or "some" embodiment(s) in several locations, this does not necessarily mean that each such reference is to the same embodiment(s), or that the feature only applies to a single embodiment. Single features of different embodiments may also be combined to provide other embodiments.

[0027] Embodiments of the present invention are applicable to any user terminal, server, corresponding component, and/or to any communication system or any combination of different communication systems where resource blocks are allocated for users. The communication system may be a wireless communication system or a communication system utilizing both fixed networks and wireless networks. The protocols used and the specifications of communication systems, servers and user terminals, especially in wireless communication, develop rapidly. Such development may require extra changes to an embodiment. Therefore, all words and expressions should be interpreted broadly and are intended to illustrate, not to restrict, the embodiment.

[0028] In the following, different embodiments will be described using, as an example of a system architecture whereto the embodiments may be applied, an architecture based on LTE/SAE (Long Term Evolution/System Architecture Evolution) network elements without, however, restricting the embodiment to such an architecture.

[0029] With reference to FIG. **1**A, let us examine an example of a radio system to which embodiments of the invention can be applied. In this example, the radio system is based on LTE/SAE (Long Term Evolution/System Architecture Evolution) network elements. However, the invention described in these examples is not limited to the LTE/SAE radio systems but can also be implemented in other radio systems.

[0030] A general architecture of a communication system is illustrated in FIG. **1**A. FIG. **1**A is a simplified system architecture only showing some elements and functional entities, all being logical units whose implementation may differ from what is shown. The connections shown in FIG. **1**A are logical connections; the actual physical connections may be different. It is apparent to a person skilled in the art that the systems also comprise other functions and structures. It should be appreciated that the functions, structures, elements, and protocols used in or for group communication are irrelevant to the actual invention. Therefore, they need not be discussed in more detail here.

[0031] The exemplary radio system of FIG. **1**A comprises a service core of an operator including the following elements: an MME (Mobility Management Entity) **108**A and an SAE GW (SAE Gateway) **104**A.

[0032] Base stations that may also be called eNBs (Enhanced node Bs) **100**A, **102**A of the radio system host the functions for Radio Resource Management: Radio Bearer Control, Radio Admission Control, Connection Mobility Control, Dynamic Resource Allocation (scheduling). The MME **108**A is responsible for distributing paging messages to the eNBs **100**A, **102**A.

[0033] FIG. **1**A shows user equipment **110**A and **114**A communicating **112**A, **118**A with the eNodeB **100**A. The user equipment refers to a portable computing device. Such computing devices include wireless mobile communication devices operating with or without a subscriber identification module (SIM), including, but not limited to, the following